

## A Cross-National Investigation of Hallucination-Like Experiences in 10 Countries: The E-CLECTIC Study

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Hallucination-like experiences (HLEs) are typically defined as sensory perceptions in the absence of external stimuli. Multidimensional tools, able to assess different facets of HLEs, are helpful for a better characterization of hallucination proneness and to investigate the cross-national variation in the frequencies of HLEs. The current study set out to establish the validity, factor structure, and measurement invariance of the Launay-Slade Hallucinations Scale-Extended (LSHS-E), a tool to assess HLEs. A total of 4419 respondents from 10 countries were enrolled. Network analyses between the LSHS-E and the 3 dimensions of the Community Assessment of Psychic Experiences (CAPE) were performed to assess convergent and divergent validity of the LSHS-E. Confirmatory factor analysis was used to test its measurement invariance. The best fit was a 4-factor model, which proved invariant by country and clinical status, indicating cross-national stability of the hallucination-proneness construct. Among the different components

of hallucination-proneness, auditory-visual HLEs had the strongest association with the positive dimension of the CAPE, compared with the depression and negative dimensions. Participants who reported a diagnosis of a mental disorder scored higher on the 4 LSHS-E factors. Small effect size differences by country were found in the scores of the 4 LSHS-E factors even after taking into account the role of socio-demographic and clinical variables. Due to its good psychometric properties, the LSHS-E is a strong candidate tool for large investigations of HLEs.

**Key words:** hallucination proneness/cross-national/measurement invariance

### Introduction

Hallucinations and related phenomena involve sensorial experiences in the absence of stimuli that are accessible

to others.<sup>1</sup> Hallucinatory phenomena occur on a spectrum ranging from vivid auditory imagery and intrusive thoughts to fully developed hallucinations.<sup>2</sup> In epidemiological studies, particularly when self-report questionnaires are used, it is customary to use the term hallucination-like experiences (HLEs) to define a broader set of experiential anomalies, allegedly indicative of overall hallucination proneness. HLEs are frequently associated with delusional beliefs of a kind often observed in psychotic disorders, which are hence defined as psychotic-like experiences (PLEs).<sup>3</sup> According to the continuum hypothesis of psychosis, HLEs and PLEs lie on a continuum from normalcy to psychotic experiences.<sup>4</sup> However, although there is a tendency to consider HLEs as a proxy indicator of a predisposition to clinically-defined hallucinations, some studies indicate that there are discontinuities. In a review on the topic, Johns et al<sup>2</sup> showed that auditory-verbal HLEs share several similarities with auditory-verbal hallucinations, but also reported that there are qualitative differences along the continuum, particularly regarding the role of risk factors in determining the transition from non-clinical to clinical status.

The investigation of HLEs is important in order to explore how perceptual anomalies become more pathological aberrations before there is a psychotic change in the way in which the sensory world is perceived and understood by a subject.<sup>5</sup> The Launay-Slade Hallucinations Scale (LSHS) is one of the most widely used tools in investigation of the occurrence of HLEs in both clinical and nonclinical samples.<sup>6-14</sup> Over time, the LSHS has been repeatedly revised. To account for different intensities of responses, the binary choice (ie, “true/false”; Launay and Slade<sup>14</sup>) was replaced with a 5-point Likert scale,<sup>8</sup> and items on visual HLEs were included.<sup>15</sup> Larøi et al<sup>9,16</sup> refined item selection to include items exploring hallucinations experienced in different sensory modalities and sleep-related experiences. However, depending on the response format used and the number of items included in the scale, different factorial structures were found. These structures included 2-factor,<sup>10,15</sup> 3-factor,<sup>6,17-19</sup> 4-factor,<sup>9,13,20-22</sup> and 5-factor<sup>16</sup> models. Furthermore, despite the globalization of research on the factor structure of the LSHS-Extended (LSHS-E), no study to date has explored the measurement invariance of this tool across countries and clinical status. The establishment of measurement invariance is a prerequisite to compare groups, since it provides evidence on whether respondents representing different clinical or socio-cultural backgrounds are interpreting a given measure in a conceptually similar manner.

#### *Cross-National Investigation of the Proportion of People With HLEs and Correlates of Hallucinations and HLEs*

There is evidence that the proportion of people with HLEs varies across countries and this may be a reflection

of differing socio-cultural backgrounds and different distribution of psychotic disorders across countries. For example, the International Pilot Study of Schizophrenia reported that, despite the similar prevalence of schizophrenia observed across countries, the proportion of people with auditory hallucinations varied considerably, from 9% in Washington (United States), to 28% in Agra (India), and up to 46% in Cali (Colombia)<sup>23</sup> (see also refs.<sup>24,25</sup>). The most recent systematic review and meta-analysis on the topic found high heterogeneity within the lifetime prevalence estimates of auditory HLEs in the general population, suggesting that factors such as age, gender, ethnicity, and participants' culture may influence prevalence rates.<sup>26</sup> The largest epidemiological investigations of the prevalence of PLEs and HLEs in general populations were the World Health Organization's World Health Survey (WHS;  $n = 250\,000$  of 52 countries);<sup>25</sup> and the World Health Organization World Mental Health Surveys (WHO-WMHS),<sup>27</sup> a coordinated set of epidemiologic prevalence surveys of mental disorders in several countries (including 31 261 adults). In the WHS, data on hallucinations conflated information on auditory and visual HLEs. Wide variance was found across countries, from rates as low as 0.58% in the Czech Republic to as high as 32.03% in Nepal.<sup>25</sup> On average, prevalence rates were higher in countries with lower-mid/low economic level according to the World Bank category (5.49 [0.11] weighted and Sex-Age Standardized Prevalence Estimates, respectively), than in countries with high or upper-mid economic levels (2.39 [0.17]). In the WHO-WMHS, lifetime prevalence rates and estimates were based on age- and gender-weighted data and were detailed for both visual (3.8% [0.2%]), and auditory HLEs (2.5% [0.1%]), again with wide variation by country.<sup>27</sup> In contrast to the WHS study, the lifetime prevalence estimates of HLEs in the WHO-WMHS were significantly higher in middle and high-income compared to the low-lower middle incomes countries. A higher prevalence of HLEs was found to be associated with being younger (16–19 years)<sup>28</sup> being female and unmarried (vs being married, in the WHS),<sup>25</sup> unemployed<sup>27</sup> and having less education.<sup>25</sup> However, in the WHS, the associations between the PLEs and socio-demographic factors were measured indirectly through the health status (the prevalence of PLEs was related to a significant decrement in health status).

#### *Aims of the Present Study*

Past research into the cross-national proportion of people with hallucinations and HLEs in the general population has been limited by the use of single-item indicators, as in the WHO-WMHS, which makes it difficult to assess the reliability of the reported experience. Moreover, studies collapsed the data on auditory and visual HLEs into a single item, as in the WHS,<sup>25</sup> and overlooked other sensorial modalities, or used a

broader construct of hallucination-proneness.<sup>28</sup> The E-CLECTIC Electronic–HalluCinationsLikeExperiencesCross-culturalInternational Consortium set out to address these limitations and to study the cross-national proportion of people with HLEs and their correlates. Multidimensional tools can be evaluated for their reliability and convergent, divergent and predictive validity, and for measurement invariance in particular, a prerequisite for comparing means across groups.<sup>29</sup> This article reports on the first wave of the E-CLECTIC, aimed at testing: (a) the reliability, convergent and divergent validity of the LSHS-E; (b) the factor structure and measurement invariance of the LSHS-E; (c) the impact of the socio-demographic and clinical factors on the different HLEs dimensions; (d) differences in the lifetime reporting of multidimensional HLEs in population samples from Europe and South America.

## Methods

The study protocol conforms to the guidelines of the 1995 Declaration of Helsinki and its revisions. The appropriate institutional ethics committee (at Sant Joan de Déu, the coordinating center, and all the involved centers) approved the study protocol. Informed consent was obtained online from all participants in accordance with the requirements of the local ethics committee. Data was collected from 11 countries across Europe (Belgium, Germany, Greece, Poland, Portugal, Spain, and United Kingdom), South America (Argentina, Brazil, and Chile), and Asia (India). However, India was excluded from analysis because not enough data was collected. Data was stored in an anonymous manner. The study was carried out between winter 2014 and summer 2016.

## Procedure

The study had a cross-sectional design and was carried out online through the Webropol Survey platform. Participants were invited through advertisements in social media (Facebook, Institutional webs, etc.), and University adverts. Participation was voluntary and no fee or other compensation was provided. Participants were required to exclude any experiences where they might have been under the effect of drugs or alcohol. Inclusion criteria were: aged 18 years and older.

## Measures

*Socio-Demographic Variables Schedule.* Self-report data on sex, age, education, civil status, occupational status, family income, and past diagnosis of a mental or neurological disorder was used to define the socio-demographic and clinical characteristics of the sample. Variables were dichotomized to examine the associations between socio-demographic factors and indicators

of HLEs. Target variables were: female (vs male); age  $\leq 25$  years (vs  $\geq 26$  years); having a university degree or higher educational qualifications (vs lower educational level); being married (vs single, divorced or widowed); being employed (vs unemployed for any reason); having a low family income (vs average or higher than average family income); having received a diagnosis of a mental disorder (vs people with no disorder).

*Launay-Slade Hallucination Scale-Extended (LSHS-E).* The 16-item LSHS-E taps into multiple sensory modalities including auditory, visual, olfactory and tactile, as well as hypnagogic and hypnopompic hallucinations and sensed presence (ie, the experience of feeling the presence of someone close who has died).<sup>9,16</sup> Respondents are asked to rate each item on a 5-point scale: (0) “certainly does not apply to me”; (1) “possibly does not apply to me”; (2) “unsure”; (3) “possibly applies to me”; and (4) “certainly applies to me”. Standard translation and back-translation procedures were followed in the adaptation of the questionnaires to languages for which a validated version was unavailable (ie, Brazilian, Chilean, Greek, Polish, Portuguese,). For each factor, the scores were calculated by adding the responses to their respective items and dividing the sum by the number of items included in the factor, so as to preserve the 0 to 4 rating. Higher scores (3 or 4) indicated a greater likelihood of experiencing the phenomena summarized in the factor.

*Community Assessment of Psychic Experiences (CAPE).* The CAPE is a 42 item self-report tool that evaluates 3 dimensions: the Positive (20 items), Negative (14 items), and Depressive (8 items) dimensions of PLEs in the general population.<sup>30,31</sup> It was primarily based on the PDI-21 and PDI-40 developed by Peters, Joseph, and Garety.<sup>32,33</sup> Each question is answered on a 4-point Likert-type response scale that ranges from almost never (1) to almost always (4). Standard translation and back-translation procedures were followed for languages for which a validated version was unavailable (Polish).

## Statistical Analysis

All data were coded and analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Additional analyses were carried out with dedicated packages running in R.<sup>34</sup> All tests were 2-tailed. Due to multiple testing, significance threshold was set at  $P < .005$ .<sup>35</sup> Scale reliability was measured using Cronbach's alpha to allow for comparison with past studies. The factor structure of the LSHS-E was tested through confirmatory factor analysis (CFA), which was carried out with the R-package *lavaan*.<sup>36</sup> The following models were compared: a 1-dimensional model, which assumes that all scale variance may be explained by a single factor;



a 2 first-order factors model (clinical and non-clinical items,<sup>10</sup> an appealing and intuitive model, albeit obtained in a different version of the scale), a 4-factor model including “intrusive thoughts,” “vivid daydreams,” “multisensory HLEs,” and “auditory-visual HLEs”, as defined in previous research,<sup>13,21</sup> and 5-factor model.<sup>16</sup> in which the auditory and visual HLE items were separated into 2 distinct factors (see [supplementary material](#) for details). Measurement invariance was calculated according to Byrne and van de Vijver<sup>37</sup> by using the R-package *semTools*.<sup>36</sup> Configural, metric and scalar invariance were tested. Models were compared on the basis of changes in Confirmatory Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA) (delta-CFI and delta-RMSEA) (see [supplementary material](#) for details).

To test for convergent and divergent validity, associations between LSHS-E and CAPE factors were explored with network analysis through the Gaussian Markov random field estimation using graphical LASSO (least absolute shrinkage and selection operator) and extended Bayesian information criterion (eBIC) to select an optimal regularization parameter. Regularization is a statistical procedure that restricts the links between variables to their unique variance, ie, after controlling for the effects of all the other variables, thus avoiding the estimation of spurious links. These analyses were done with the *bootnet* package for R.<sup>38</sup> Graphical representations were computed using the *qgraph* package for R.<sup>39</sup>

The role of socio-demographic and clinical variables in the distribution of scores on the dimensions (or factors) of the LSHS-E that were extracted by the best CFA model was tested with a series of multivariate analyses of covariance (MANCOVA). For each variable, we assessed its relationship with the construct measured by the LSHS-E dimensions by taking into account all other variable as covariates. The following variables were entered into these analyses: sex, age, education, civil status, employment, family income, and diagnosis, as previously defined. Statistics were calculated on the basis of the Pillai's trace, since it is the most conservative measure against type I error due to multiple tests and violations of homogeneity of covariance (matrices).<sup>40</sup> With large samples the procedure is rather robust to violation of assumptions. Partial  $\eta^2$  was used as a measure of effect size, with values of 0.0099, 0.0588, and 0.1379 as threshold for small, medium, and large effect size.<sup>41</sup>

Sensitivity analysis was conducted to explore any potential effects of caffeine, tobacco, marihuana, and alcohol on the HLEs. Spearman correlation was performed to analyze the associations between substance use and the 4 LSHS-E factors. The impact of substance use in the distribution by country of 4 LSHS-E factors was explored with MANCOVA, also taking socio-demographic and clinical variables into account (see [supplementary materials](#) for details).

## Results

A total of 4419 participants from 10 countries were involved in the study. Participants were predominantly young, with 80% of the sample  $\leq 35$  years. About two-thirds of the sample were women ([table 1](#)).

A minority of participants (18%) was from low-income families. About an eighth of the sample reported having been diagnosed with a mental disorder ( $n = 547$ ; 12.3%), including anxiety disorders ( $n = 114$ ; 2.6%); depression ( $n = 309$ ; 7%); bipolar disorder ( $n = 25$ ; 0.6%); schizophrenia spectrum disorders ( $n = 8$ ; 0.2%); other (ie, anorexia or bulimia nervosa; personality disorders;  $n = 91$ ; 2.1%). Overall, 86 participants (1.9%) self-reported a diagnosis of neurological disorder, whereas 7 participants (0.2%) did not specify whether they had been diagnosed with a psychiatric or neurological disorder.

### *Reliability of the LSHS-E Across Countries*

Reliability of the LSHS-E, as indicated by Cronbach's alpha, was good, with values above the conventional threshold of 0.7 for all countries except Argentina ( $\alpha = .69$ ). Reliability was good in all countries for all dimensions of the CAPE ([supplementary table S1](#)).

### *Frequency of HLEs on the LSHS-E*

The proportion of participants who selected the possibly applies to me (3) or certainly applies to me (4) responses on LSHS-E varied from 7% to 64% depending on the experience assessed ([figure 1](#)).

Sleep-related (ie, hypnagogic and hypnopompic) HLEs were reported with higher frequencies (33%–42%) than auditory or visual hallucinatory HLEs (7%–12%).

### *The Factor Structure of the LSHS-E Across Countries*

The CFA models were initially tested on participants who did not report a diagnosis of a mental or neurological disorder ( $n = 3779$ ). Subsequently, 2 sets of measurement invariance CFA were applied: one to assess measurement invariance across countries; and the other to verify whether the best model was invariant between people who reported a diagnosis of mental disorder and those who did not.

In people who did not report a diagnosis, all CFA models were identified and all models reached the threshold for a good fit, except on the chi-square test, as is often the case with large samples. McDonald's omega was suboptimal but still acceptable ([supplementary table S2](#)). The models with the best fit were the 5-factor and the 4-factor models. However, the 5-factor model had a factor with just 2 items. Thus, the 4 factors model was judged to be the most parsimonious model with the best fit and was consequently selected for interpretation and invariance testing. In this model, factor

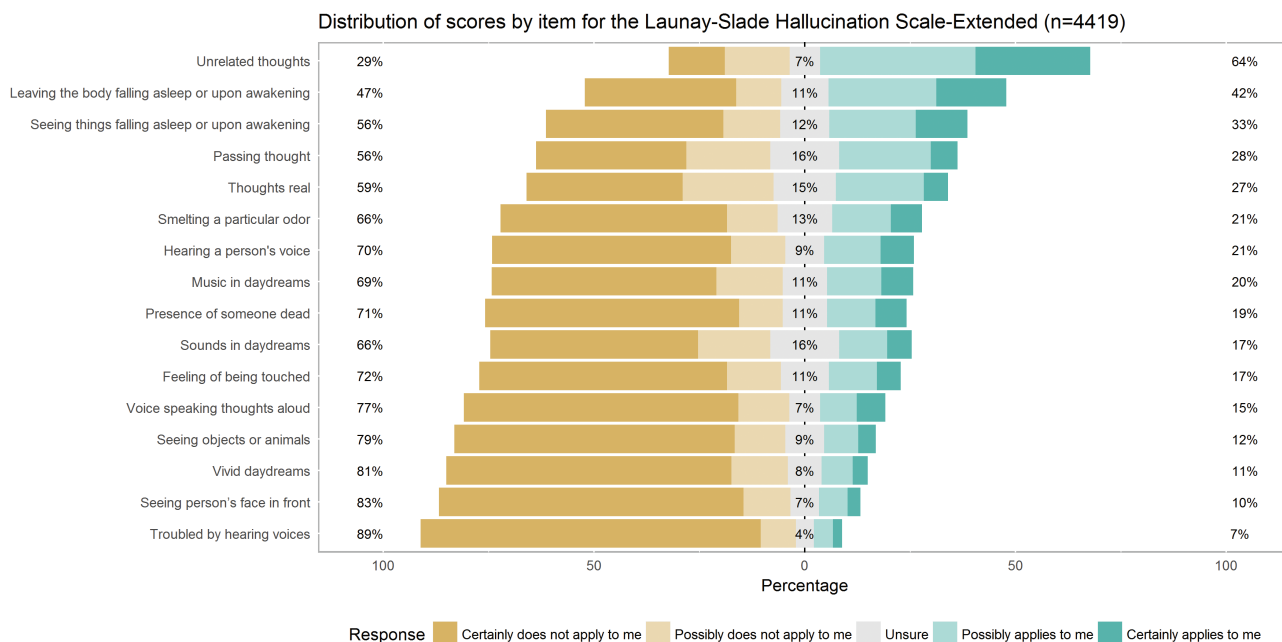
**Table 1.** Sample Characteristics by Country

Country	Sample	Male / Female	Age Mean (Range)	Diagnosis of Mental Disorder	Family Income (Less Than Average)	Civil Status (Single, Divorced or Widowed)	Employment (Unemployed or Student)	Education (Lower Education)
Europe								
Belgium	306	65 / 241	28.7 (19–68)	16 (5.2%)	62 (20%)	259 (84.6%)	230 (75.2%)	44 (14.4%)
Germany	296	92 / 204	29.3 (19–69)	73 (24.7%)	164 (55%)	218 (73.6%)	213 (72%)	182 (61.5%)
Greece	229	93 / 136	33.1 (21–63)	14 (6.1%)	29 (13%)	157 (68.6%)	103 (45%)	88 (38.4%)
Poland	100	31 / 69	30.5 (20–68)	18 (18.0%)	11 (11%)	41 (41%)	42 (42%)	26 (26%)
Portugal	154	50 / 104	32.8 (19–65)	19 (12.3%)	11 (7%)	96 (62.3%)	68 (44.2%)	58 (37.7%)
Spain	342	91 / 251	37.8 (18–68)	28 (8.2%)	38 (11%)	145 (42.4%)	43 (12.6%)	104 (30.4%)
United Kingdom	62	21 / 41	30.1 (18–45)	15 (24.2%)	13 (18%)	39 (62.9%)	22 (35.5%)	8 (12.9%)
South America								
Argentina	92	39 / 53	25.1 (19–65)	5 (5.4%)	5 (5%)	43 (46.7%)	66 (65%)	44 (4.3%)
Brazil	137	37 / 100	39.4 (18–69)	41 (29.9%)	2 (1%)	62 (45.3%)	37 (27%)	24 (17.5%)
Chile	2701	1025 / 1676	26.5 (19–68)	318 (11.8%)	472 (17%)	2339 (86.6%)	2159 (80%)	2212 (81.9%)
Grand total	4419	1544 / 2875	28.9 (18–69)	547 (12.3%)	807 (18%)	3399 (76.9%)	2923 (66%)	2750 (62.0%)

1 can be labeled “intrusive thoughts” (items: 1, 2, 3); factor 2 can be seen as representing “vivid daydreams” (items 5, 6, 7); factor 3 can be labeled “multisensory HLEs” (items: 11, 12, 13, 14, 15) and factor 4 is related

to “auditory-visual HLEs” (items: 4, 8, 9, 10, 16) (supplementary figure S1).

Table 2 summarizes the results of the measurement invariance CFA across countries. The best model was



**Fig. 1.** Distribution of scores by item for the LSHE-E in the sample. The items are ranked according to the frequency of positive endorsement.

**Table 2.** Fit Indexes for Invariance Tests of the 4-Factor Model Across Countries (Sample:  $n = 3874$ ; 5 Countries)

	<i>N</i>	$\chi^2$	df	<i>P</i>	CFI	RMSEA (90% CI)	McDonald's Omega		
Belgium	306	108.03	98	.229	0.995	0.018 (0.000–0.036)	0.854		
Chile	2701	464.72	98	.0001	0.982	0.037(0.034–0.041)	0.862		
Germany	296	71.23	98	.981	1.000	0.000 (0.000–0.000)	0.851		
Greece	229	64.57	98	.996	1.000	0.000 (0.000–0.000)	0.858		
Spain	342	63.68	98	.997	1.000	0.000 (0.000–0.000)	0.863		
Not included in the measurement invariance CFA									
Brazil	137	50.37	98	1.000	1.000	0.000 (0.000–0.000)	0.904		
Poland	100	78.26	98	.929	1.000	0.000 (0.000–0.017)	0.871		
Portugal	154	48.96	98	1.000	1.000	0.000 (0.000–0.000)	0.903		
It could not be calculated									
Argentina	92								
United Kingdom	62								
Measurement invariance CFA across 5 countries								delta-CFI	delta-RMSEA
Configural invariance		775.38	490	.0001	0.989	0.027 (0.024–0.031)			
Metric invariance		1050.94	538	.0001	0.981	0.035 (0.032–0.038)	0.008	0.008	
Scalar invariance		1596.82	586	.0001	0.963	0.047 (0.044–0.050)	0.018	0.012	
Threshold for good fit				$P > .05$	$> .90$	$< .08$	$< .01$	$< .02$	

Note: CFA, confirmatory factor analysis.

implemented in all countries with large enough samples for model convergence (excluding Argentina and the United Kingdom). A good model-fit was found in all country-samples (table 2).

Measurement invariance was conducted across the 5 countries with enough data for this analysis (ie, Belgium, Chile, Germany, Greece, and Spain). Fit was good in all countries and across all levels of the measurement invariance test. There was some degradation of the fit from configural to scalar invariance, with the delta-CFI but not the delta-RMSEA above the conventional threshold for invariance acceptability. However, the MacCallum et al<sup>42</sup> test of small differences in fit suggested that the differences were negligible for each nested comparison ( $P > .1$ ).

Supplementary table S3 summarizes the results of the measurement invariance CFA between people who did not report a mental or neurological diagnosis ( $n = 3779$ ) and people who reported a diagnosis of a mental disorder ( $n = 547$ ). Results indicated an optimal fit in both samples. Measurement invariance was deemed acceptable at all levels of comparison.

#### Convergent and Divergent Validity of the LSHS-E

In the network analysis, the 4 LSHS-E factors were linked more with positive symptoms as measured by the CAPE than with negative or depression dimensions (figure 2). The auditory-visual HLE factor had the strongest link with the CAPE positive symptoms factor. However, compared with putatively “healthy” people,

those who reported a diagnosis of a mental disorder showed a greater influence of the “intrusive thoughts” factor in the association between the auditory-visual HLEs factor and the CAPE positive symptoms dimension:  $r = .19$  vs  $r = .31$ ; Fisher  $r$ - $z$  transform test,  $z = 2.8$ ;  $P = .01$  (figure 2).

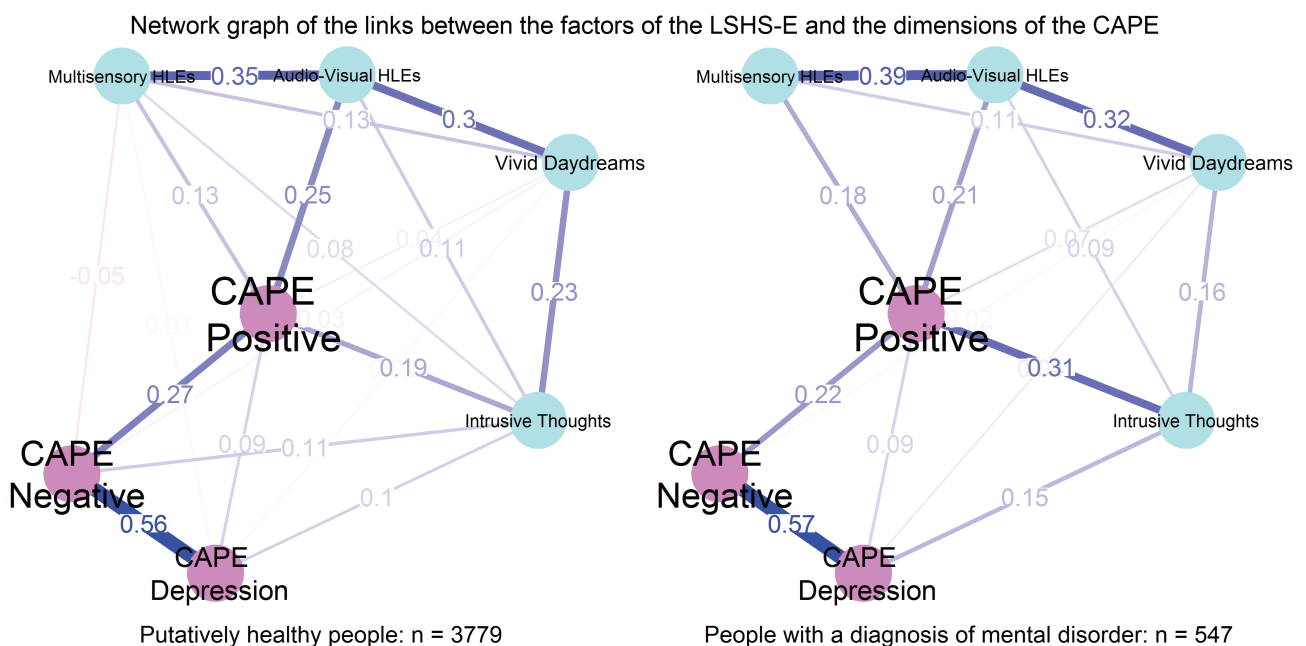
Overall, the networks did not differ: van Borkulo network invariance test,  $M = 0.124$ ;  $P = .072$ .

#### Impact of Socio-Demographic and Clinical Variables on the 4 LSHS-E Dimensions

After taking into account all other variables, in the whole sample women scored higher than men, particularly on the intrusive thoughts and multisensory HLEs dimensions of LSHS-E. The effect size of this difference was modest. Being married, having a university degree or higher education, and being employed were related to lower scores on the LSHS-E dimensions. The effect sizes of these associations were small. People who reported a diagnosis of a mental disorder scored higher on the LSHS-E dimensions, both overall and on each factor. After taking into account all other variables, age, and family income were not related to the LSHS-E dimensions (see supplementary table S4 for the details).

#### Differences by Country on the 4 Dimensions of the LSHS-E

Taking into account the socio-demographic and clinical variables, scores on the LSHS-E dimensions differed by



**Fig. 2.** Network graph of the links among the 3 dimensions of the CAPE and the 4 factors of the LSHS-E in putatively healthy people (on the left) and in people who reported a diagnosis of a mental disorder (on the right). Colors correspond to different assessment tools (CAPE vs LSHS-E). Thickness of the lines is proportional to the estimated correlation coefficients, which are superimposed on the lines. Positive correlations are in “powder blue”; negative correlations are in “violet”.

sample at country level, both overall and on each single dimension. The effect sizes of these differences were small (table 3 and supplementary table S5).

Participants from Belgium and Poland, and Brazil in some aspects sometime, tended to score higher than participants from other countries, while participants from Argentina and Portugal tended to score lower than participants from other countries. Overall, there was a large overlap among countries' samples as far as scores on the LSHS-E dimensions were concerned (figure 3).

#### *Impact of Substance Use on the 4 Factors of the LSHS-E, by Taking Sociodemographic and Clinical Variables Into Account*

Overall, 33.4% of people reported to smoking, 79.1% consumed caffeine, 81.6% alcohol, and 28.5% marihuana. People rarely (<1%) reported the use of other substances (heroin, cocaine, hallucinogenic mushrooms, ecstasy), which were excluded from further analysis. Marihuana and tobacco were positively related to the LSHS-E dimensions (except to vivid daydreams for tobacco). Caffeine was negatively related to all dimensions (except to multisensory HLEs) and alcohol was only related to Auditory-visual HLEs (supplementary table S5). Taking into account substance use, and socio-demographic and clinical variables, the differences on the 4 LSHS-E dimensions by country did not change significantly (supplementary table S6).

## Discussion

This study provides evidence for the use of the LSHS-E as a tool to measure hallucination-proneness in epidemiological studies. Across 10 countries from Europe and South-America, reliability of the LSHS-E was good, allowing comparison across groups of its scores. CFA confirmed that the LSHS-E scores distribute into 4 correlated dimensions or factors having the best fit. The most important contribution of this study is the demonstration that the best model as retrieved by CFA was reproducible across countries and measurement invariance of the model could be demonstrated in 5 countries that had enough data for the algorithm to converge. This finding confirmed that the multidimensional articulation of hallucination proneness can be reproduced across countries with different languages and cultures. Other studies have confirmed the multidimensionality of this scale in various versions.<sup>6,9,16,18–22</sup> However, structures often differed depending on the version of the LSHS used in each study. This study replicated the 4-factor structure of the LSHS-E as reported by previous studies,<sup>13,20,21</sup> providing some consistency for 4-factors of the propensity to experience HLEs in the general population. Moreover, this version fully matches the factor-structure reported by Larøi<sup>9</sup> in one of the original studies.

Convergent and divergent validity of these dimensions were good when measured with the tool for the assessment of PLEs, the CAPE. As expected, the 4 factors identified were more closely related to the CAPE positive dimension than to the negative and depressive dimensions.

#### *Impact of Socio-Demographic and Clinical Factors on HLEs*

People who reported having received a diagnosis of a mental disorder were more likely to admit HLEs than healthy people and scored higher on the 4 LSHS-E dimensions even when socio-demographic variables were taken into account. Conversely, people with a high educational level, those who declared themselves married and those who reported having a job scored lower than their counterparts on the 4 LSHS-E dimensions. This is in line with past studies that also showed that young age, being unemployed and being unmarried was associated with the reporting of HLEs.<sup>27,43,44</sup> Although the reasons for this are not fully understood, it can be speculated that older people or those who are more educated are also more aware that such experiences may be labeled as odd or socially undesirable, but these speculations are yet to be backed up empirically. Other explanations that have been put forward are that the impact of age might be due to a physiological, neurodevelopmental stage favoring the expression of psychosis proneness<sup>45</sup> and that hallucinations might be less prevalent in highly-educated populations because of their strong association with social adversity that is less prevalent in groups with higher-socioeconomic status.<sup>46</sup>

Women scored higher than men with modest effect sizes on the intrusive thoughts and multisensory HLEs dimensions. Previous studies reported a greater occurrence of HLEs in women across countries with different cultural belonging.<sup>27,47</sup> Morokuma et al observed, in a population of Japanese adolescents, that the prevalence of auditory-verbal HLEs was higher among girls than boys.<sup>47</sup> A similar result was found in a study including 5000 16-year-old twins.<sup>48</sup> Likewise, women with schizophrenia were found more likely to report hallucinations than men.<sup>49</sup> There is no clear explanation for greater reporting of HLEs and hallucinations by girls/women than boys/men. One possibility is the greater propensity of women to disclose symptoms of distress,<sup>50</sup> with HLEs being related to distress in both clinical and nonclinical samples.<sup>2</sup>

Among participants who reported a diagnosis of a mental disorder, the dimension of “intrusive thoughts” had a more central role in the network, including both HLEs and PLEs, than in the healthy people. Although repeated measurement designs are necessary to establish temporal associations, we can speculate that the presence of intrusive thoughts may be a crucial factor in generating hallucinations in people with psychosis.<sup>51</sup> According to some authors, hallucinations originate from a failure

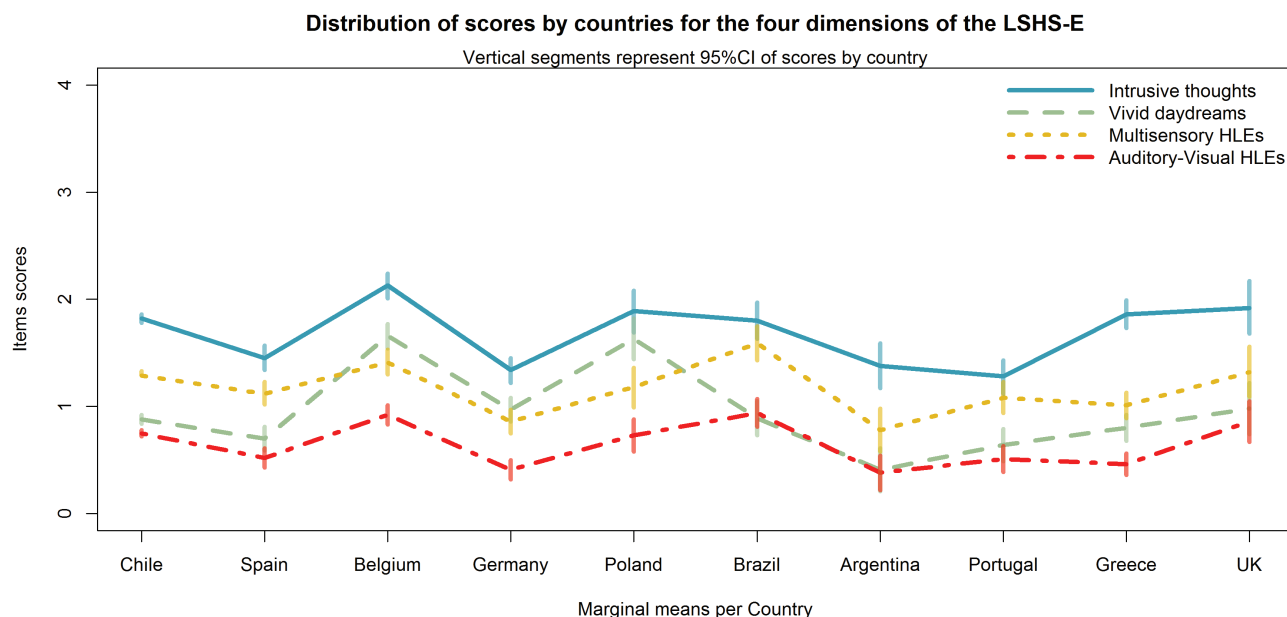


**Table 3.** Multivariate Impact of Country on LSHS-E Dimensions Taking Into Account Socio-Demographic and Clinical Variables ( $n = 4263$ )

Variable	Levels	Estimated Marginal Means (With 95% CI)				MANCOVA		
		They are Adjusted for any Other Variable in the Model				Multivariable Statistics		
		Intrusive Thoughts*	Vivid Daydreams*	Multisensory HLEs*	Auditory-Visual HLEs*	Pillai's Trace	F value	Partial $\eta^2$
Country	Belgium	2.13 (2.01–2.24)	1.66 (1.54–1.77)	1.41 (1.30–1.53)	0.92 (0.83–1.01)	0.136	$F(36; 16984) = 16.5$ ; $P < .0001$	0.034
	Germany	1.34 (1.22–1.45)	0.97 (0.86–1.08)	0.86 (0.75–0.97)	0.41 (0.32–0.50)			
	Greece	1.86 (1.73–1.99)	0.80 (0.68–0.92)	1.01 (0.89–1.13)	0.46 (0.36–0.56)			
	Poland	1.89 (1.69–2.08)	1.63 (1.44–1.82)	1.18 (0.99–1.36)	0.73 (0.58–0.88)			
	Portugal	1.28 (1.12–1.43)	0.64 (0.49–0.79)	1.08 (0.94–1.23)	0.51 (0.39–0.63)			
	Spain	1.45 (1.34–1.57)	0.70 (0.59–0.81)	1.12 (1.02–1.23)	0.52 (0.43–0.61)			
	United Kingdom	1.92 (1.68–2.17)	0.98 (0.74–1.22)	1.32 (1.09–1.56)	0.86 (0.67–1.05)			
	Argentina	1.38 (1.17–1.59)	0.41 (0.21–0.61)	0.78 (0.58–0.98)	0.38 (0.22–0.54)			
	Brazil	1.80 (1.63–1.97)	0.89 (0.73–1.05)	1.59 (1.43–1.75)	0.94 (0.81–1.07)			
	Chile	1.82 (1.78–1.86)	0.88 (0.84–0.92)	1.29 (1.25–1.33)	0.75 (0.72–0.78)			

*Note:* LSHS-E, Launay-Slade Hallucinations Scale-Extended. People who declared a past neurological disorder were excluded. For some variables, information was occasionally missing. Multivariate analyses of covariance (MANCOVA) - Between subjects statistics.

\* $P < .0001$ .



**Fig. 3.** Distribution of scores by countries for the 4 dimensions of the LSHS-E as estimated by CFA: Intrusive thoughts; Vivid daydreams; Multisensory HLEs; Auditory-Visual HLEs. Data are marginal means as estimated on the basis of the multivariate analyses of covariance (MANCOVA) taking into account the role of socio-demographic and clinical variables. Vertical segments represent 95% CI of the means.

of the self-monitoring mechanism, the misattribution of these experiences to an external source.<sup>52,53</sup> In particular, Bentall et al<sup>54</sup> have suggested that traumatic experiences may lead to intrusive thoughts that occur spontaneously without the individual having control over them<sup>55</sup> and their presence can complicate discrimination between thoughts and external stimuli. Another possibility could be that intrusive thoughts and HLEs might represent a variation of the same phenomenon, which is described in different ways by different people. Raballo<sup>51</sup> has argued that the HLEs are phenomena arising from the general transformation of the thought stream. Humpston,<sup>56</sup> further, argued that auditory-verbal HLEs are the results of a thought process, and suggested that the intensity of thinking and related distress might cause an alienation from unwanted thoughts that then turn into auditory-verbal HLEs.

#### *Cross-National Differences on the 4-Factors of HLEs*

Finally, differences by country samples were found in the HLEs scores of the 4 LSHS-E dimensions even after taking into account the role of socio-demographic and clinical variables. Participants from Belgium and Poland, and Brazil in some aspects, tended to score higher than participants from the other countries, while participants from Argentina and Portugal tended to score lower than participants from the other countries. Overall, differences by country samples were small in terms of effect sizes. In the WHS,<sup>57</sup> authors observed a significant association between HLEs, other PLEs and income inequality after controlling for the per capita income of a country,

regime type and number of years of democracy. We failed to find a relationship between family income and HLEs, although we did not investigate the role of income inequality. It should be borne in mind that the context is not limited to circumstantial details, such as family income, but also involves macroscopic, transindividual aspects, such as culture and language. Culture is likely to shape the content of HLEs, guide their appraisal, model the behavioral reaction, and affect the individual's willingness to disclose the experience.<sup>58</sup> Additional factors related to a society's culture, such as public attitudes and self-stigma, may have an impact on the reporting of HLEs<sup>59</sup> and the distress associated with them.<sup>13</sup> Furthermore, other factors such as use of cannabis and other drugs could be related to HLEs. In fact, a recent review<sup>60</sup> reported that healthy individuals attributed their HLEs to substance consumption. In this study, the differences on the 4 dimensions across countries were unaffected from substance use. Future studies are needed to explore this issue more in depth.

#### *Strengths and Limitations*

This study was entirely based on self-report tools, and this might have introduced some bias into responses (eg, social desirability). However, self-report measures favor the enrollment of large samples. As anonymity of data was guaranteed, participants might have been more forthcoming in replying to the questionnaires. Furthermore, the following limitations have to be considered. First, we did not ask for information on participants' ethnic backgrounds, so we were unable to explore ethnic correlates

of HLEs in the first wave of the E-CLECTIC. Second, only people that have Internet access could answer the surveys, which may explain the low participation rates among older people and people with lower income. Third, among the countries that were involved in the measurement invariance analysis 4 were European, and the fifth was Chile, which has been significantly influenced by Spanish culture; this limits the generalization of findings to different cultures. The results can be considered valid for EU countries, and South American countries heavily populated by individuals with European heritage, but still have to be confirmed in non-WEIRD (Western, Educated, Industrialized, Rich and Democratic) countries. However, we also included countries with different, non-Spanish cultural backgrounds: Belgium, Germany, Greece, and Poland. Fourth, we enrolled convenience samples, which cannot be considered representative of the populations of interest. Nevertheless, the analysis we did can be informative at the lower boundaries of what can be observed in representative samples. Last but not least is the inclusion of countries with predominantly European heritage and a common religious background. Religion might have an impact on hallucinatory experiences. Previous studies showed that religious practices might be adopted as a strategy to cope with the stress caused by these experiences.<sup>61</sup>

### Future Directions

In the second wave of the E-CLECTIC, a more in-depth investigation of the links between hallucination proneness and different cultural features such as ethnic, religious, regional and political affiliation,<sup>58</sup> and the role of migrant status<sup>43</sup> will be explored in countries with different cultural backgrounds. Our proposal is to use the LSHS-E in future studies to explore the multidimensionality of the HLEs. The findings presented in this study indicate measurement invariance across countries with different linguistic backgrounds and among people who might or not have received a diagnosis of a mental disorder. This ensures that the LSHS-E can be used to monitor HLEs in different European and South-American cultures. This is promising in regard to extending the survey to include further cultures in future research that could also include an assessment of cultural values (eg, collectivism vs individualism) in order to be able to test for the impact of culture in a more direct manner. A better understanding and awareness of the diversity of people's attitudes toward hallucinations based on their cultural background may eventually help clinicians, to take into account a person's cultural background when assessing and treating hallucinations and respond appropriately to the distress experienced by patients.<sup>58,62</sup>

### Supplementary Material

Supplementary material is available at <https://academic.oup.com/schizophreniabulletin/>.

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